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A QUALITATIVE STUDY OF THE NODULATING ABILITY OF LEGUME SPECIES: LIST 2

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Abstract

215 species of legumes indigenous to Southern Africa were examined for root nodules. Only three species (belonging to the Caesalpinioideae) were consistently found to be without root nodules. Of the listed species, 207 had apparently not previously been examined for their ability to produce root nodules.

Uittreksel

'N KWALITATIEWE STUDIE VAN DIE VERMOË VAN PEULPLANTSOORTE OM WORTELKNOPPIES TE VORM.
215 peulplantsoorte wat inheems aan suidelike Afrika is, is vir wortelknoppies ondersoek. Op slegs drie spesies (lede van die Caesalpinioideae) is deurgaans geen knoppies aangetref nie. 207 van die gelyste plantsoorte is skynbaar nog nie van te vore vir wortelknoppies ondersoek nie.

Introduction

Apart from reports by Mostert (1955) and Grobbelaar et al (1967) little is known about the nodulating ability of the 1 400-odd legumes (Phillips, 1951) that are indigenous to the Republic of South Africa, South West Africa, Botswana, Lesotho and Swaziland.

In an attempt to remedy this state of affairs a long-term survey was initiated at this laboratory some years ago and the present paper presents information obtained since the previous report was published by Grobbelaar et al (1967).

Procedure

The procedure was identical to that published earlier in greater detail (Grobbelaar et al, 1967). Where possible, plants were examined in the field for root nodules. In other cases plants were grown from seed in pots containing nitrogen-poor media and their roots were examined periodically for nodules. If nodules did not form within a reasonable time, the substrate was enriched with *Rhizobium* suspensions from available cultures and/or with soil from the natural habitat of the plants when this was possible.

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Annuals which failed to nodulate in at least three consecutive pot trials and perennials which did not nodulate within at least two years, were regarded as not being able to nodulate under local conditions.

Herbarium voucher specimens were prepared of all species tested. The specimens were identified at the Botanical Research Institute, Pretoria and deposited in the herbarium of the Department of General Botany, University of Pretoria.

Prof. and Mrs. Allen of the University of Wisconsin, U.S.A., have been compiling a card index of all available data regarding the nodulation of legumes for many years. The results of the present investigation are therefore regularly transmitted to them and they in turn indicate through personal correspondence whether other reports (published or personal) are available regarding the nodulating ability of the species concerned. The information obtained from the Allens is included in the present communication because it is especially valuable in cases where negative results have been obtained in different parts of the world for the same species, as this would suggest a suitable *Rhizobium* strain probably does not exist for the legume concerned.

RESULTS AND DISCUSSION

The species on which information is provided are listed in table 1. Although the species are listed alphabetically within the genera, the genera, tribes and sub-families are arranged according to the system of de Dalla Torre & Harms (1963). The present list contains only species which are indigenous to the

TABLE 1
LIST OF INDIGENOUS LEGUME SPECIES EXAMINED FOR NODULATION

Plant Species	Herbarium Specimen Number*
IMMOSOIDEAE	
Acacieae Benth.	
Acacia hebeclada DC. ssp. hebeclada	19366
A. nebrownii Burtt Davy	17694
A. polyacantha Willd. ssp. campylacantha (Hochst. ex Rich.) Brenan	17693
A. reficiens Wawra ssp. reficiens	24572
A. stuhlmannii Taub.	20619
A. welwitschii Oliv. ssp. delagoensis (Harms) Ross & Brenan	17729
CAESALPINIOIDEAE	
Cynometreae Benth.	
Colophospermum mopane (Kirk ex Benth.) Kirk ex J. Léon	18306
Amherstieae Benth.	
Schotia capitata Bolle	16121
S. latifolia Jacq.	16122
Cassieae Benth.	
Cassia capensis Thunb. var. keiensis Steyaert	17555

TABLE 1—*continued*

LIST OF INDIGENOUS LEGUME SPECIES EXAMINED FOR NODULATION

Plant Species	Herbarium Specimen Number*
PAPILIONATAE	
Sophoreae Spreng.	
Sophora inhambanensis Klotzsch	19166
Calpurnia intrusa (R.Br.) E. Mey	20729
C. villosa Harv.	16615
Podalyrieae Benth.	
Cyclopia genistoides (L.) R. Br. var. genistoides	22953
C. montana Hofm. & Phill. var. glabra Hofm. & Phill.	22907
Podalyria biflora (L.) Willd	19176
P. calyptrata (Retz.) Willd	17571
P. glauca (Thunb.) DC.	23677
P. sericea (Andrew) R. Br.	19174
Genisteae Bronn.	
Priestleya calycina L. Bolus	22900
P. elliptica DC.	22899
P. sericea E. Mey	16588
P. tomentosa (L.) Druce	22950
P. vestita DC.	21682
Borbonia lanceolata L.	17680
Rafnia amplexicaulis Thunb.	22932
R. angulata Thunb.	16613
R. crassifolia Harv.	16817
R. cuneifolia Thunb.	20906
R. elliptica Thunb.	16818
R. opposita Thunb.	16599
R. ovata E. Mey	16819
R. perfoliata E. Mey	16611
R. triflora Thunb.	22951
Lotononis calycina (E. Mey.) Benth.	22856
L. eriantha Benth.	18291
L. florifera Dümmer	17669
L. hirsuta Schinz	22857
L. involucrata Benth.	22799
L. laxa Eckl. & Zeyh. var. multiflora Dümmer	22927
L. peduncularis Benth.	22917
L. prostrata Benth.	22904
Pearsonia aristata (Schinz) Dümmer	16884
P. atherstonei Dümmer	16881
P. marginata Dümmer var. marginata	19192
P. podalyriaefolia Dümmer	16812
Lebeckia cytisoides Thunb.	22786
L. plukenetiana E. Mey.	22810
L. sericea Thunb.	22940
L. simsiana Eckl. & Zeyh.	22784
L. wrightii Bol.	21683
Wiborgia armata Harv.	16824
W. obcordata Thunb.	16600
Aspalathus abietina Thunb.	16610
A. acicularis E. Mey. ssp. acicularis	22920
A. acuminata Lam. ssp. acuminata	17691
A. albens L.	22796
A. alopecurus Benth.	17690
A. araneosa L.	16603
A. argyrophanes R. Dahlgr.	17689

TABLE 1—*continued*

LIST OF INDIGENOUS LEGUME SPECIES EXAMINED FOR NODULATION

Plant Species	Herbarium Specimen Number*
A. aspalathoides (L.) R. Dahlgr.	20918
A. asparagoides L.f. ssp. rubro–fusca (Eckl. & Zeyh.) R. Dahlgr.	17688
A. astroites L.	20915
A. biflora E. Mey	22800
A. bracteata Thunb.	16605
A. capensis (Walp.) R. Dahlgr.	22956
A. carnosa Berg	16594
A. cephalotes Thunb. ssp. cephalotes	16586
A. cephalotes Thunb. ssp. violacea R. Dahlgr.	16589
A. chenopoda L.	16593
A. ciliaris L.	16601
A. commutata (Vog.) R. Dahlgr.	16992
A. cordata (L.) R. Dahlgr.	16609
A. crassisepala R. Dahlgr.	17687
A. crenata (L.) R. Dalhgr.	21688
A. divaricata Thunb. ssp. divaticata	16607
A. ericifolia L. ssp. ericifolia	22902
A. ericifolia L. ssp. minuta R. Dahlgr.	18242
A. flexuousa Thunb.	17686
A. gerrardii Bol.	20733
A. hispida Thunb. ssp. hispida	16796
A. hystrix L.f.	17546
A. juniperina Thunb.	16797
A. lactea Thunb. ssp. adelphea (Eckl. & Zeyh.) R. Dahlgr.	16989
A. laeta Bol.	22878
A. laricifolia Berg. ssp. canescens (L.) R. Dahlgr.	17684
A. linearis (Burm. f.) R. Dahlgr. ssp. linearis	20905
A. linguiloba R. Dahlgr.	22870
A. macrantha Harv.	22802
A. microphylla DC.	16617
A. muraltioides Eckl. & Zeyh.	16591
A. nigra L.	22955
A. opaca Eckl. & Zeyh. ssp. opaca	17682
A. retroflexa L. ssp. retroflexa	16619
A. salteri L. Bol.	18274
A. sericea Berg. ssp. sericea	21679
A. spicata Thunb. ssp. neglecta (Salter) R. Dahlgr.	16799
A. spicata Thunb. ssp. spicata	18273
A. spinescens Thunb. ssp. lepida (E. Mey) R. Dahlgr.	22939
A. stenophylla Eckl. & Zeyh. ssp. garciana R. Dahlgr.	20917
A. teres Eckl. & Zeyh. ssp. teres	22801
A. ulicina Eckl. & Zeyh. ssp. ulicina	16800
A. uniflora L. ssp. uniflora	18254
Buchenroedera tenuifolia Eckl. & Zeyh. var. pulchella (E. Mey.) Harv.	17677
Dichilus strictus E. Mey.	16966
Melolobium alpinum Eckl. & Zeyh.	17668
M. candicans Eckl. & Zeyh.	16985
M. microphyllum Eckl. & Zeyh.	17652
Crotalaria capensis Jacq.	18293
C. globifera E. Mey.	20731
Argyrolobium adscendens Walp.	16794
A. candicans Eckl. & Zeyh.	17549
A. lanceolatum Eckl. & Zeyh.	16982
A. patens Eckl. & Zeyh.	17551

TABLE 1—*continued*

LIST OF INDIGENOUS LEGUME SPECIES EXAMINED FOR NODULATION

Plant Species	Herbarium Specimen Number*
A. pumilum Eckl. & Zeyh. var. verum	18268
A. transvaalense Schinz	16795
Hypocalyptus sophoroides (Berg.) Druce	17641
Galegeae Bronn.	
Indigofera alternans DC.	16807
I. angustifolia L.	22791
I. bainesii Bak.	19370
I. bifrons E. Mey.	17557
I. brachystachya E. Mey	16808
I. burkeana Benth.	16962
I. cardiophylla Harv.	17638
I. comosa N.E. Br.	19449
I. coriacea Ait. var. cana Harv.	16810
I. cryptantha Benth. var. occidentalis Bak. f.	16967
I. cytisoides Thunb.	22914
I. daleoides Benth.	19454
I. delagoaensis Bak. f. ex Gillett	20903
I. digitata Thunb.	17559
I. dimidiata Vogel	22477
I. discolor E. Mey.	22929
I. dissimilis N.E. Br.	19434
I. egens N.E. Br.	18303
I. filicaulis Eckl. & Zeyh.	17674
I. filiformis Thunb.	17673
I. filipes Benth.	16928
I. flavicans Bak.	19480
I. garckeana Vatke	16887
I. gerrardiana Harv.	22891
I. glomerata E. Mey.	21687
I. hilaris Eckl. & Zeyh.	17672
I. holubii N.E. Br.	16934
I. humifusa Eckl. & Zeyh.	22811
I. laxeracemosa Bak. f.	22830
I. longipes N.E. Br.	22820
I. macra E. Mey.	19479
I. malacostachys Benth.	17560
I. melanadenia Benth.	17715
I. ovata Thunb.	20900
I. oxytropis Benth.	18283
I. oxytropoides Schltr.	22910
I. parviflora Heyne ex Wight & Arn. var. parviflora	16935
I. podophylla Benth. ex Harv.	19167
I. poliotes Eckl. & Zeyh.	17646
I. pretoriana Harms	23757
I. procumbens L.	17639
I. psoraleiodes L.	17640
I. reducta N.E. Br.	22826
I. rehmannii Bak. f.	16886
I. subulata Vahl. ex Poir.	19448
I. sulcata DC.	17558
I. swaziensis Bolus	16936
I. tenuissima E. Mey.	20909
I. tomentosa Eckl. & Zeyh.	22922
I. tristis E. Mey	16964

TABLE 1—*continued*
LIST OF INDIGENOUS LEGUME SPECIES EXAMINED FOR NODULATION

Plant Specis	Herbarium Specimen Number*
I. woodii Bol.	17671
I. zeyheri Spreng	18260
Psoralea aphylla L.	16814
P. asarina (Berg) Salter	17656
P. capitata Linn. f.	17655
P. cordata (L.) Salter	16602
P. decumbens Ait.	16815
P. fruticans (L.) Druce	16785
P. imbricata (L.f.) Thunb.	16604
P. laxa Salter	16616
P. oligophylla Eckl. & Zeyh.	17654
P. restioides Eckl. & Spach	20914
P. rotundifolia L.	22815
P. tomentosa Thunb.	18288
P. wilmsii Harms	16816
Tephrosia capensis (Jacq.) Pers. var. acutifolia E. Mey.	16965
T. linearis (Willd) Pers. ssp. discolor (E. Mey.) Gill.	17665
T. polystachya E. Mey. var. latifolia Harv..	16889
T. semiglabra Sond.	18265
T. sparsiflora H. M. Forbes	16974
T. tzaneenensis H. M. Forbes	16932
Lessertia depressa Harv.	17648
L. harveyana Bolus	17650
L. harbacea (L.) Druce	17670
L. incana Schinz	22946
L. perennans DC. var. polystachya (Harv.) L. Bolus	20730
L. rigida E. Mey.	22905
L. thodei Bolus	22908
Hedysareae DC.	
Aeschynomene nodulosa (Bak.) Bak. f.	21490
A. nyassana Taub.	16939
Stylosanthes fruticosa (Retz) Alston	16173
Phaseoleae Bronn.	
Rhynchosia adenodes Eckl. & Zeyh.	17663
R. angulosa Schinz.	16821
R. capensis (Burm.) Schinz	17658
R. caribaea (Jacq.) DC. var. picta (E. Mey.) Bak. f.	17762
R. clivorum S. Moore	16956
R. densiflora DC.	20901
R. erecta DC.	17675
R. komatiensis Harms	16937
R. minima (L.) DC. var. prostrata (Harv.) Meikle	16973
R. monophylla Schltra.	16614
R. nervosa Benth. var. petiola Burtt Davy	18296
R. pentheri Schltr. var. pentheri	22903
R. thorncroftii (Bak. f.) Burtt Davy	18298
E. kraussianum Meisn.	20735
E. polystachyum Bak.	16804
E. salignum E. Mey.	17642
E. villosum (Meisn.) C.A. Smith ex Burtt Davy	20734

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* Voucher herbarium specimens deposited in the herbarium of the Dept. of General Botany, University of Pretoria, Pretoria.

Republic of South Africa, S.W. Africa, Botswana, Lesotho and or Swaziland. Of the 215 species listed in table 1 only the first nine were tested in pot experiments; the observations on the others were made in the field.

Root nodules were found on all the species except *Colophospermum mopane*, *Schotia capitata* and *Schotia latifolia*—three of the four members of the Caesalpinioideae investigated. According to the Allens, *Schotia latifolia* was previously investigated by other workers for nodulation and these workers also failed to observe any. No record appears to exist of a previous investigation concerning the nodulating ability of *Colophospermum mopane* or *Schotia capitata*.

Of the species listed in table 1 on which nodulation was observed in the present study, *Lebeckia simsiana*, *Indigofera alternans*, *Indigofera cryptantha* var. *occidentalis*, *Indigofera macra*, *Indigofera oxytropis*, *Indigofera subulata*, *Aeschynomene nodulosa* and *Rhynchosia erecta* were previously investigated for nodulation. All of them were found to produce root nodules (Allen & Allen, Personal Communication). According to the Allens, the remaining 207 species on which nodulation was observed in the present study, have not been previously examined for this ability.

Although certain members of the Mimosoideae and Papilionatae appear to be unable to nodulate, the available information indicates that it is especially members of the Caesalpinioideae which lack this ability (Allen & Allen, 1961; De Souza, 1966; Grobbelaar et al, 1967). The negative results that were obtained with the three species from this sub-family during the present study therefore conform with the overall picture which emerged from earlier studies.

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